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Wood As Energy

An Overview: Biomass as an Energy Resource- Promise and Problems

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Prepared by the staff of
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INTRODUCTION

This information package represents an effort on the part of the staff of the National Agricultural Library to assemble a variety of information about an important current topic. The lead essay prepared by a knowledgeable expert in the field discusses in some depth the specific issue.

FROM THE LITERATURE provides a representative sampling of literature available on the subject. Much of these materials were selected from the AGRICOLA database of the National Agricultural Library. An NAL call number is given for titles in the collections of the Library. The Library does not maintain a collection of audiovisual materials in this subject area. Sources are listed from which slide and filmstrips may be acquired.

The listings of **CURRENT RESEARCH** and **DEMONSTRATION PROJECTS** are taken from several databases. CRIS (Current Research Information System) is a computer based information storage and retrieval reporting system for publicly supported agricultural and forestry research in the United States. For further information contact Current Research Information Systems, NAL Building, Beltsville, MD 20705 (telephone 301-344-3850). Descriptions of demonstration projects were provided by the NARS (Narrative Accomplishment Reporting Systems) of the Extension Service, USDA, NAL Building, Beltsville, Md, 20705, telephone (301) 344-3750.

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Biomass as an Energy Resource - Promise and Problems

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On a national basis the United States consumes about 78.2 quads of energy annually (1 quad = 1 x 10 BTU's) (Klass 1981). At the present time, wood is supplying about 2 percent of this total, or 1.3 to 1.8 quads. This is half of what is generated from hydroelectric sources and sixty percent of what is generated from nuclear sources (Zerbe 1981). The largest advantage that wood has, especially over fossil fuels, is its renewability. The United States has sizable reserves of wood that are currently unutilized, which under specific economic or political circumstances could be used for energy.

The largest consumer of energy from wood and biomass is the forest products industry, which is about fifty percent energy self-sufficient (Zerbe 1981). Processing of wood to forest products generates considerable amounts of residues which may be used as fuels. These residues are attractive as an energy source because they are largely used on site, which means that no transportation costs are incurred, and because they may be at least partially dried (Haygreen and Bowyer 1982).

The partial dryness of these residues is a critical attribute for utilization as a fuel. Oven dry hardwoods have fuel values of 8000-8500 BTU's per pound, softwoods have values of 8600-9700 BTU's per pound, while the heat of combustion for bark is somewhat higher than for wood. Seldom, however, is wood or biomass found in an oven dry condition in general use. The moisture present in wood drastically decreases the net amount of energy that can be obtained and the efficency with which the fuel is burned. Based on these data the amount that could be paid for wood as fuel, to obtain an equivalent amount of energy in comparison to other fuels is quite high.

Another problem in the industrial use of wood as fuel is the storage of the material. Green chips at 100% moisture content (oven dry basis) have a density of twenty-four pounds per cubic food and a fuel value of 2869 BTU's per pound. Outside storage of material can, of course, cause fluctuations in the moisture content, and thus the net net fuel values of the residues, due to climatic changes. In an attempt to minimize the fluctuations, various storage methods have been considered, but are not without cost.

While manufacturing residues are readily available and quantifiable source of fuel, they represent a fairly small proportion of the total biomass available for conversion to energy. The total includes growth over cut, insect, disease, and fire killed trees, waste products from urban areas and land clearing and logging residues (Zerbe 1981). While this material represents a large resource base, it also creates problems in its assessment and collection which has been the topic of many studies (McClure et al. 1981, Johnson 1979).

By far the largest proportion of available biomass is consumed by direct combustion in the firing of industrial boilers (Zerbe 1981). There is, however, a growing interest in the reforming of wood or biomass from its solid form to denser and more familiar forms of fuel, or to chemical feedstocks. The commonest methods of reforming involve: fermentation of the sugars present to ethanol or other alcohols and the thermal processes of pyrolysis and gasification.

Up to this point we have been primarily concerned with the use of biomass or its reaction products as energy; a topic that has received a great deal of attention since 1973-74 and the beginning of the "energy crisis." There are limitations, however, to the contribution biomass can make to the total energy picture. If we assume that the United States consumes 78.2 quads of energy annually, and the potential of biomass from forested areas is the equivalent of 9.5 quads, we are talking about a maximum of 12 percent of our total energy budget with complete utilization. A more conservative estimate is a total of 400 million tons or 6.5 quads from both forest and agricultural sources resulting in less than 10 percent of our national energy demand (Goldstein 1981). Processing and reforming steps, as outlined above, exact a thermodynamic price from the gross energy content of biomass, such that it has been indicated that if the 400 million tons of available biomass were converted to liquid and gaseous fuels, they would only account for about 3 percent of our present energy needs (Goldstein 1981b).

In concert with the energy crisis, however, is a materials crisis, since most modern materials are derived from hydrocarbons. Currently, 7.5 percent of all gaseous and liquid fuels are used for petrochemicals, accounting for about 4.7 quads of energy. Approximately 4 percent (60 million tons or 2.5 quads) are used to formulate chemicals with the remainder used for process fuel. On a mass basis, the 400 million tons of available biomass, even at 15 percent conversion efficiencies could displace the 60 million tons of petrochemical feedstocks (Goldstein 1981b). These data

represent not only potential feasibility based on the availability of the raw material, but also the fact that the value of derived chemicals from biomass is much greater than the value if the biomass is used strictly for fuel (Glasser 1981).

Economic Impacts

As of 1976, there were some 560 million tons of biomass available for conversion to chemicals and energy from the forests of the United States. With a resource of this magnitude available, why isn't there more activity towards its utilization? The problem includes not only efficient utilization, but also economical collection and transportation of the biomass. Although our timber supply is increasing in absolute terms, the materials are not in sizes, species or locations that are desirable to major timber processors (Young 1980).

A method that has been practiced to a limited extent, and is the focus of a number of studies, is that of whole tree harvesting. This problem has been addressed in an ambitions project in which a prototype mobile harvester has been developed. This machine is designed to enter residual stands after conventional logging and harvest the remaining material for use as energy and in composite forest product (Koch 1982, Koch and Savage 1980). More conventionally, the harvesting of wood for energy or for other products is a mechanized, multi-step process. The first step is that of felling the tree, either with chain saws or the use of machines known as feller-bunchers, which are capable of shearing small trees and accumulating the stems. The felled trees are then transported with a rubber tired or tracked machine called a skidder to a concentration point or landing. From the landing, the stems may be loaded directly onto trucks for transportation or chipped in the woods and blown into large covered trailers. Wholetree chipping requires a large initial equipment investment and produces chips that are somewhat dirty and may be suitable only for energy, not for other fiber purposes. On the positive side, however, this type of harvesting may increase the wood yield from an area and provides a use for unmerchantable material. Furthermore, the site is largely prepared for replanting a more profitable species (Clifton et al. 1979).

Assuming that woody material can be economically delivered, another group of considerations must be evaluated in order to make ration decisions with regard to the use of woody biomass as energy (O'Grady 1980):

1. What is the effective price of the fuel? This is a function of the stumpage price, or the price at the procurement point, the cost of handling and transportation, and the efficiency of conversion.
2. What investments are required? This includes handling and storage systems, conversion equipment (such as the wood fired boiler itself), and pollution abatement equipment.
3. What are the operating costs? This reflects the cost of labor, utilities, supervision and overhead.
4. Are there any unique problems? These conditions would vary with each installation, but may include the cost of capital, return on investment requirements, and any tax advantages that may accrue from the use of wood for energy.
5. Is the fuel source secure? Is the fuel source availability reliable in the long term?

Power plants that use wood for energy may require an initial investment of 200 to 700 percent more than those that use conventional oil or gas units, or roughly $20,000-30,000 per million BTU's per hour (O'Grady 1980). A number of methods have been developed which examine the economic feasibility of conversion to wood as a fuel source (Gustashaw 1981, Ellis 1978, Skog 1978).

The conversion of wood to liquid or gaseous fuels although technically feasible has resulted in variable economic claims. Baker (1980) has reported that only large plants of $50-100 million capital investment would make the hydrolysis and fermentation of wood to ethanol a viable fuel option. He cites high investment and operating costs as the major problem. Roberts et al. (1980) claim that a 1000 oven dry ton per day plant using a steam explosion process would require a capital investment of $67,400,000 to produce ethanol at $1.92 per gallon. The price drops to $1.52 per gallon by going to a 2000 oven dry ton per day plant and further reductions in price may accrue from the sale of pentose sugars and lignin. Wayman et al. (1979), using an enzymatic process reported potential prices of $1.34-1.42 per gallon. It is interesting to note that in both of these papers, a major component of the final price is the cost of the woody raw material, accounting for about 25 percent of the price of the produced ethanol.

Cost data for the thermal processing of biomass to fuels is difficult to obtain because of the low number of operational commercial installations. Capital costs for gasifiers are reported to range from $75,000-313,000 for capacities of 4-21.5 million BTU's per hour, respectively, resulting in system costs of $0.94-0.65 per million BTU's (Farley and Zeemont 1980). Retrofitting of an existing conventional boiler to an up draft gasification unit was found to result in considerable savings, with a payback period of 1.59 years (Birchfield and Bullpitt 1980).

It is the contention of some authors that the future utilization of wood and biomass lies not in the conversion to fuels, since these sources can only provide a small portion of our national energy needs, but in reforming to chemical intermediates (Goldstein 1981b, Palsson 1981). According to Goldstein (1981c), an integrated plant that would convert hardwood into ethanol, phenol, and furfural would be profitable at current prices. It has been predicted that by 1990 the petrochemical industry will begin to decline, with at least 50 percent of the feedstocks coming from non-petroleum sources (Goldstein 1981a). Palsson et al. (1981) contend that efficient market penetration by biomass derived chemicals will require transformation not to high value species, but into lower priced intermediates such as short-chain, linear olefins. To effect large scale utilization, however, current prices must be lowered to 20-40 percent of estimated chemical prices. Glasser (1981) has examined the relative values of lignin used for fuel as opposed to chemicals, and found that the value added by chemical utilization, to be considerable compared to that added by use for fuel.

Finally, how will increased utilization of wood for energy impact on the traditional uses of wood for fiber and solid wood products? A survey of eight southern states (Clifton et al 1979) indicated a considerable interest on the part of industrial energy users, in the use and retrofitting of boilers for the combustion of wood, such that by the year 2000, wood fuel demand may be 12.8-25.6 million tons annually. Concern has been voiced, that the development of the energy potential contained in our forested lands be conducted in an orderly manner that would decrease the possibility of over reaction (Society of American Foresters 1979). Possible problems to be avoided are the diversion of raw materials from established uses and overly rapid expansion of harvesting activities that could result in local over supplies.

Environmental Impacts

The use of wood or biomass for fuel has potential environmental advantages over conventional fuels. The emissions contain no sulphur and very low amounts of nitrogen, but carbon monoxide, particulate matter, and visible emissions can be of concern (Junge 1980, O'Grady 1980). The ash from the combustion of wood, which amounts to 0.5-5 percent of the dry weight does not present major disposal problems. Primary emission standards can usually be met with cyclone systems, but in larger systems (50 million BTU's per hour and greater), secondary devices such as scrubbers and electrostatic precipitators may be used. Visible emissions in the form of smoke can usually be controlled by monitoring of the interactions between fuel moisture, fuel to air ratios, and by proper firebox design (O'Grady 1980).

The environmental impacts of using wood for energy are not limited to air quality, but include those associated with increased removal of biomass from the site. These impacts may result in nutrient depletion, increased runoff and erosion, soil compaction, and aeration, increased soil temperature, and depletion of wildlife habitat (Pimentel et al. 1981, Clifton et al. 1979). Conventional logging operations leave considerable amounts of residue on the site, which is usually burned to release the nutrients that it contains. There is evidence, however, that indicates removal of logging debris alone will not severely degrade the nutrient levels of a site, because most of the nutrients are found in the foliage and small branches that usually remain. More intensive removals, including whole tree utilization can result in serious depletion of minerals (Kitto 1980). This may ultimately mean that fertilizers will be needed, raising another series of questions on the environmental, economic and energetic (since most fertilizers are petrochemically derived) consequences. In contrast, it has been said that whole tree chipping with regard to unmerchantable hardwoods left on sites after logging, may result in well-prepared sites through the removal of cull trees. Preparation of this type is routinely done before reforestation is begun, and may cost as much as $50 per acre (Society of American Foresters 1979), but with this type of utilization may turn a cost into a profit.

Conclusion

It has been the intent of this paper to acquaint the reader with basic facts with regard to wood and biomass as a source of chemicals and energy. Biomass is not a panacea capable of totally supplying our needs, but under a particular set of conditions, and with the appropriate technology, may be able to decrease the consumption of fossil-based products.

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Wood Chips vs. Densified Biomass: An Economic Comparison (Fuel Costs in Atlantic Canada). D. Jones and J. Jones. In Energy from Biomass and Wastes, Symposium papers presented January 21-25, 1980, Lake Buena Vista, Florida. Chicago, Ill., The Institute of Gas Technology, 2980. p. 233-249.
(NAL Call No.: TP360.E54)

Wood Residue Potential for Energy. John I. Zerbe. (In Proceedings Bio-Energy '80 World Congress and Exposition. 1980. p. 51-52.
(NAL Call No.: TP360.B527 1980)

Wood Residue Recovery in the National Forests. Hearing before the Subcommittee on Environment, Soil Conservation, and Forestry of the Committee on Agriculture, Nutrition, and Forestry, United States Senate, Ninety-sixth Congress, First Session on S. 1996, November 30, 1979, Missoula, Mont. U.S. Congress Senate Committee on Agriculture and Forestry, Washington, U.S. Government Printing Office. 1980. 131 p. (NAL Call No.: KF26.A3543 1979b)

SLIDE SETS & FILMS

Downed Woody Fuels Inventory [Slide] United States National Wildlife Coordinating Group. Washington, The Group: distributed by National Audiovisual Center, 1980.
135 slides, col. 2x2 in. + cassette (27 min.)

These Are Our Forests [Motion Picture] U. S. Forest Service. Washington, D.C., U. S. Department of Agriculture, Motion Picture Service: distributed by National Audiovisual Center, 1979.
1 reel, 14 min.: sd., col. (16 min.)

CURRENT RESEARCH AND DEMONSTRATION PROJECTS

AVAILABILITY OF FOREST BIOMASS FOR INDUSTRIAL PRODUCTION IN APPALACHIAN SOUTH CAROLINA

0082499
AGENCY: OCI SC.Z
PERIOD: 08 JAN 80 TO 31 DEC 80
INVEST: NIX L E; SHAIN W A; NODINE S K
PROJECT#: SCZ01420-FR
PERF ORG: FORESTRY
LOCATION: CLEMSON UNIV
CLEMSON SC

OBJECTIVES:To determine the availability of forest biomass for industrial power production in the Appalachian counties of South Carolina. To determine the above relative to biological productivity of forest, demand for conventional forest products, the current energy requirements of region, land usage, terrain, transportation, and location of potential customers.

BIOMASS POTENTIAL FOR ENERGY PRODUCTION IN THE NORTHEAST

0087531
AGENCY: SAES NY.C
PERIOD: 01 MAY 82 TO 30 SEP 85
INVEST: KALTER R J; BOISVERT R N
PROJECT#: NYC-121345
PERF ORG: AGRI ECONOMICS
LOCATION: CORNELL UNIVERSITY
ITHACA NY

OBJECTIVES:Develop a data base for determining the availability of crops, agricultural residues and food processing wastes in the Northeast for conversion into energy products; assess the commercial feasibility of producing energy from biomass, including its sensitivity relative to the type of feedstock, transportation costs, energy prices, plant scale, and the policy environment; evaluate technical and economic factors affecting the utilization and disposal of byproducts from biomass energy production and to assess the implications of a biomass energy industry on land use and environmental and food policy.

CULTURE AND POTENTIAL OF WOODY BIOMASS PLANTATIONS FOR ENERGY AND FIBER

0083037
AGENCY: CSRS WN.P
PERIOD: 01 OCT 80 TO 01 OCT 85
INVEST: HEILMAN P
PROJECT#: WNP00532
PERF ORG: FORESTRY & RANGE MANAGEMENT
LOCATION: W WASHINGTON RES-EXT CENTER
PUYALLUP WN

OBJECTIVES:Increase yields through genetic selection, hybridization and cultural techniques. Determine soils, irrigation and fertilizer requirements. Investigate species suitable for wet and other problem soils.

PUBLICATIONS:82/01 82/12
HEILMAN, P. 1982. Nitrogen and organic matter accumulation in coal mine spoils supporting red alder stands. Can. J. For. Res. 12:000-000 (WSU Sci. Paper 6122).
HEILMAN, P. and STETTLER, R.F. 1982. Problems and potential for mixed plantings of Alnus rubra and cottonwood for biomass. In: Abst. of 2nd Int. Sym. on N(2) Fix. with non-legumes. Ag. Inst. Can. and Can. Soc. Microbiol.

Banff, Can., HEILMAN, P. and STETTLER, R.F. 1982. Problems and potential for mixed plantings of Alnus rubra and cottonwood for biomass. In: Abst. of 2nd Int. Symp. of N(2) Fix. with non-legumes. Ag. Inst. Can. and Can. Soc. Microbiol. Banff, Can.,

ENERGY AND ENVIRONMENTAL ANALYSES OF AGRICULTURAL AND BIOMASS PRODUCTION SYSTEMS

0082536
AGENCY: SAES NY.C
PERIOD: 01 JUL 80 TO 30 SEP 83
INVEST: PIMENTEL D; SORRELLS N R; BURGESS M
PROJECT#: NYC-139315
PERF ORG: ENTOMOLOGY
LOCATION: CORNELL UNIVERSITY
ITHACA NY

OBJECTIVES:Assess energy, labor, land and water resource inputs in agricultural and biomass production systems to determine the energy, environmental and economic benefits and risks of specific production systems.

PUBLICATIONS:82/01 82/12
PIMENTEL, D. 1981. The food-land-fuel squeeze. Chem. Tech. 11:214-215.
PIMENTEL. D. 1981. Food, energy, and the environment. Proc. N.S. Inst. Sci. 31:85-100. PIMENTEL. D. 1981. Grains for food or fuel. Energy Policy Research and Information Program, Publication Series No. 81-3. Purdue U niversity,

West Lafayette, Indiana. 21 pp.
PIMENTEL, D. 1981. Energy and food. BiogScience 31:791.
PIMENTEL, D. 1982. The vanishing land. pp. 104-115 In: The National Research Council Issues and Studies 1981-1982. National Academy Press, Washington, D.C. 206 pp.

ENERGY EFFICIENCY IN AGRICULTURAL BIOMASS PRODUCTION AND PROCESSING

0084482
AGENCY: CSRS IND
PERIOD: 07 MAY 81 TO 30 SEP 85
INVEST: PEART R M
PROJECT#: IND046021
PERF ORG: AGRI ENGINEERING
LOCATION: PURDUE UNIVERSITY
WEST LAFAYETTE IND

OBJECTIVES:Develop systems and proceaures for integrating energy crop prodiction (or crop by-product use) into conventional crop production. Design and develop methods of reducing energy use and/or substituting solar, wind or biomass energy in crop processing.

PUBLICATIONS:82/01 82/12
BENDER, D.A., PEART, R.M. and BAGBY, M.D. 1982. Systems Dynamics of Energy Crops. ASAE Paper No. 82-3089. ASAE.

St. Joseph, MI.
BARRETT, J.R. and PEART, R.M. 1982. Systems Simulation in U.S. Agriculture. In: Progress in Modeling and Simulation, pp. Academic Press, Lindon.
PEART, R.M. 1982. Farm-Grown Fuels. Engineering 1982, pp. 21-23, ABET, Inc., NY.
PEART, R.M. and PUCKETT, H.B. 1982. Feed Processing and Animal Feeding. Agr.
Eng. 63(2):18-19, 1982.

ENERGY PRODUCTION FROM DIRECT SEEDED WOODY BIOMASS

0084216
AGENCY: CSRS ILLU
PERIOD: 01 OCT 81 TO 30 SEP 86
INVEST: WHITE T A; DAWSON J O; ROLFE G L
PROJECT#: ILLU-55-0347
PERF ORG: FORESTRY
LOCATION: UNIVERSITY OF ILLINOIS
URBANA ILL

OBJECTIVES:To determine species most suitable for direct seeding. Evaluate weed control techniques for direct seeding. Evaluate species site relationships. Evaluate relationship between establishment density and yield. Determine impact of high density woody biomass on soil nutrient status including nitrogen fixation.

PUBLICATIONS:82/01 82/12
WHITE, T.A. and ROLFE, G.L. 1982. Tolerance of direct-seeded black locust (Robinia pseudoacacia L.) to herbicides. Ill. Agr. Exp. Sta. For. Res. Rep. (In Press).

HARVESTING COSTS AND BIOMASS AVAILIBILITY IN SOUTHWESTERN OREGON

0085797
AGENCY: SAES OREZ
PERIOD: 01 SEP 81 TO 30 JUN 82
INVEST: PERRY D A; BROWN G W
PROJECT#: ORE-FS-184-S
PERF ORG: FOREST SCIENCE
LOCATION: OREGON STATE UNIV
CORVALLIS ORE

OBJECTIVES:Determine volume of hardwoods available for biomass energy use in Southwestern Oregon, and cost of harvest and transport to mill.

PRODUCTION OF BIOMASS FOR ENERGY ON ABANDONED FARMLANDS

0075850
AGENCY: SAES VT.
PERIOD: 01 APR 78 TO 30 SEP 86
INVEST: LAING F M
PROJECT#: VT00905
PERF ORG: BOTANY
LOCATION: UNIVERSITY OF VERMONT
BURLINGTON VT

OBJECTIVES:Evaluate hardwood trees and shrubs providing highest biomass potential on short cutting cycles. Compare yields from native against introduced species. Evaluate harvesting, transportation and utilization of biomass. Examine portions of yield as potential feed stuff. Model economic comparisons from land preparation to utilization.

PRODUCTION OF BIOMASS FOR ENERGY ON LANDS OF LIMITED AGRICULTURAL USE

0081200
AGENCY: CSRS NY.C
PERIOD: 25 MAR 80 TO 31 DEC 81
INVEST: LATHWELL D J; GROVE T L
PROJECT#: NYC-125438
PERF ORG: AGRONOMY
LOCATION: CORNELL UNIVERSITY
ITHACA NY

OBJECTIVES:Characterize soil, water and climatic properties of land resources of limited use for traditional agriculture; evaluate the potential biomass production of plant species; match highly productive plants to available soil resources; and measure the productivity of selected wetland species experimentally.

SCREENING SPECIES FOR WOODY BIOMASS PRODUCTION

0087003
AGENCY: SAES FLA
PERIOD: 07 JUL 81 TO 31 DEC 84
INVEST: ROCKWOOD D L
PROJECT#: FLA-FOR-02158-BG
PERF ORG: FOREST RESOURCES & CONSERVATN
LOCATION: UNIV OF FLORIDA
GAINESVILLE FLA

OBJECTIVES:Screen new woody species in simulated energy plantation for estimating their productivity of biomass for methane.

PUBLICATIONS:82/01 82/12

ROCKWOOD, D.L., COMER, C.W., DIPPON., D.R., HUFFMAN, J.B., RIEKERK, H. and WANG, S. 1983. Woody Biomass Production Research in Florida. Proc. 42nd Ann. Meet. Fla. Soil and Crop Sci. Soc. Accept. for Pub.
ROCKWOOD, D.L. 1982. Sceening Species for Woody Biomass Production Annual Report. GRI/IFAS Methane from Biomass and Waste Program. Unpub.
GILREATH, J.P., PITMAN, W.D. and ROCKWOOD, D.L. 1983. Production of Nonconventional Crops for Methane Feedstocks. Proc. 1983 Internat. Gas Res. Conf. Accept. for Pub.

UTILIZATION OF BIOMASS FOR ENERGY

0087390
AGENCY: SAES IND
PERIOD: 01 OCT 82 TO 30 SEP 87
INVEST: BARRETT J R; RICHEY C B
PROJECT#: IND046023
PERF ORG: AGRI ENGINEERING
LOCATION: PURDUE UNIVERSITY
WEST LAFAYETTE IND

OBJECTIVES:Develop technology & equipment for using biomass as a renewable energy source. Design equipment and determine operational procedures for direct burning, gasification or pyrolysis of agricultural materials. Analyze potential harvest, transport, and storage systems. Study energy efficiency in integrated pest management related to increased biomass utilization.

PUBLICATIONS:82/10 82/12

KUTZ, L.J. 1982. Characteristics of Operation of a Downdraft Channel Gasifier/Combustor Furnace. MS Thesis. Purdue University, W. Lafayette, IN 47907, 96 pp.

RICHEY, C.B., BARRETT, J.R. and FOSTER, G.H. 1982. Biomass Channel-Gasification Furnace. TRANS. ASAE 25(1):2-6.

BARRETT, J.R., JACKO, R.B. and SUMNER, H.R. 1982. Corn Residue Furnace Emissions. TRANS. ASAE (In Press).

BARRETT, J.R. and PEART, R.M. 1982. Systems Simulation in U.S. Agriculture. In: Progress in Modelling Simulation, (Cellier, F.E. ed.), Academic Press, Inc. (London) Limited, pp. 39-59.

KUTZ, L.J., BARRETT, J.R., RICHEY, C.B. and JACKO, R.B. 1982. Downdraft Channel Gasifier Operation and Particulate Emissions. ASAE Paper No. 82-3096. Am. Soc. of Ag. Engrs., St. Joseph, MI 49085.

WOODY BIOENERGY CROPS ON MARGINAL LAND

0085816
AGENCY: CSRS MIN
PERIOD: 15 SEP 81 TO 30 SEP 83
INVEST: FARNHAM R S
PROJECT#: MIN-25-024
PERF ORG: SOIL SCIENCE
LOCATION: UNIV OF MINNESOTA
ST PAUL MIN

OBJECTIVES:Research on promising species of woody bioenergy crops such as Salix (willows), alnus (alder) and Populus (hybrid poplar) species. Objectives include varietal screening, population density, rottional periods, and management and cultural practices. Evaluation of field and greenhouse fertility studies, soil and tissue analyses, hydrological assessment and the economic feasibility of woody bioenergy production system on marginal land.

PUBLICATIONS:82/01 82/12

FARNHAM, R.S., BERGUSON, W.E., LEVAR, T.E. and SHERF, D.B. 1982. Woody Bioenergy crop production on marginal wetlands. In: Proc. of 19th annual symposium of North American poplar council, Rhinelander, Wisc. p. 135-145.

FARNHAM, R.S., GARTON, S., REED, P.E. and LOUIS, K.A. 1982. Propagation and establishment of Bioenergy plantations. In: Proc. of 2nd int'l. Seminar of energy conservation and use of renewable energies in the Bio-Industries, GARTON, S., HOSIER, M.A. READ, P.E. and FARNHAM, R.S. 1981. In vitro propagation of Alnus glutinosa. Hort. Science, Vol. 16(6). Dec.

WOODY BIOMASS PRODUCTION PILOT TESTS

0087002
AGENCY: SAES FLA
PERIOD: 07 JUL 81 TO 31 DEC 84
INVEST: ROCKWOOD D L; FISHER R F; SULLIVAN E T
PROJECT#: FLA-FOR-02159-BG
PERF ORG: FOREST RESOURCES & CONSERVATN
LOCATION: UNIV OF FLORIDA
GAINESVILLE FLA

APPROACH: Locate sites (40 ha each if possible) and cooperators for pilot energy farm tests; site prepared, plant, fertilize (with commercial materials or sludge as appropriate) and manage in a way that operational costs and energy inputs can be collected for an economic/energetic analyses; establish measurement plots so that annual yields can be assessed and optimum rotation period determined for each genotype selected for the test species (eucalyptus and pine).

PUBLICATIONS: 82/01 82/12

ROCKWOOD, D.L., COMER, C.W., DIPPON, D.R., HUFFMAN, J.B., RIEKERK, H. and WANG, S. 1983. Woody Biomass Production Research in Florida. Proc. 42nd Ann. Meet. Fla. Soil and Crop Sci. Soc. Accepted for Pub.

ROCKWOOD, D.L. and DIPPON, D.R. 1982. Woody Biomass Production Pilot Tests Annual Report. GRI/IFAS Methane from Biomass and Waste Program. Unpub.

AG1077 BIOMASS ENERGY DEMONSTRATIN IN POULTRY FACILITY - ALABAMA

THE POTENTIAL OF USING WOOD AS AN ENERGY SOURCE TO HEAT BROILER HOUSES HAS CREATED CONSIDERABLE INTEREST AMONG BROILER PRODUCERS. INCREASE COST OF LP GAS AND THE AVAILABILITY OF WOOD IN MOST RURAL SECTIONS OF ALABAMA ALONG WITH THE COMMERCIAL DEVELOPMENT OF WOOD FURNACES OF THE SIZE AND TYPE REQUIRED FOR POULTRY FACILITIES ARE FACTORS CONTRIBUTING TO PRODUCER'S INTEREST IN USING WOOD AS AN ENERGY SOURCE.
THE ALABAMA COOPERATIVE EXTENSION SERVICE, ALABAMA POWER COMPANY, AND HICKMAN POULTRY COMPANY OF GORDO, ALABAMA COOPERATED IN THE DEMONSTRATION. TWO IDENTICAL BROILER HOUSES OWNED BY HICKMAN POULTRY WERE USED. ONE OPERATED USING THE CONVENTIONAL METHOD OF HEATING USING LP GAS AND THE OTHER HOUSE USING A WOOD FURNACE CAPABLE OF PRODUCING 400,000 BTU'S PER HOUR.
DURING THE DEMONSTRATION THE FOLLOWING WERE MONITORED FOR BOTH HOUSES: INSIDE AND OUTSIDE TEMPERATURE AND RELATIVE HUMIDITY; ENERGY CONSUMPTION; BIRD PERFORMANCE AND PROCESSING DATA.
RESULTS OF DEMONSTRATIONS SHOWED A $17.11 ENERGY COST SAVINGS PER 1,000 BIRDS WHEN USING THE WOOD FURNACE OVER CONVENTIONAL METHODS. THERE WERE NO SIGNIFICANT DIFFERENCES IN BIRD PERFORMANCE OR PROCESSING QUALITY. WOOD CAN BE USED AS ENERGY SOURCE ECONOMICALLY IF WOOD AND LABOR ARE AVAILABLE NEAR USER.
DEMONSTRATION IS CONTINUING AND HOPED TO BE EXPANDED WHEN ECONOMIC CONDITIONS IN POULTRY INDUSTRY WILL ALLOW. RESEARCH IS NEEDED IN MORE AUTOMATED SYSTEMS.
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(205-826-4955)

AG883 BIOMASS ENERGY FOR POULTRY BROODING IN OREGON

SPIRALLING COST OF PROPANE GAS HAS IMPOSED ECONOMIC PRESSURE ON OREGON POULTRY PRODUCERS TO EXPLORE ALTERNATE ENERGY SOURCES FOR BROODING. THE PRACTICALITY AND ECONOMICS OF USING BIOMASS HEAT TO PROVIDE A QUASI-WARM BROODING SITUATION TO HELP REDUCE PROPANE USAGE AND OVERALL COST OF ENERGY FOR BROODING WAS PROVEN IN A RESEARCH/DEMONSTRATION PROJECT CONDUCTED IN TWO ALMOST IDENTICAL 50 BY 400-FOOT, 32,000-BIRD BROILER HOUSES ON A COOPERATING COMMERCIAL POULTRY FARM. ONE HOUSE WAS CONVERTED TO BROODING WITH A SUPPLEMENTAL BIOMASS HEAT, THE OTHER WAS USED AS A CHECK OR COMPARISON UNIT. WOOD PELLETS, THE FORM OF BIOMASS USED, ARE AN OREGON RESOURCE, ARE LOCALLY AVAILABLE, AND LEND THEMSELVES TO SIMPLE AND PRACTICAL AUTOMATIC FURNACE FEEDING AND BURNING CONTROL. A COMMERCIALLY-MANUFACTURED, AUTOMATIC FEED, WOOD PELLET FURNACE WAS USED FOR THE DEMONSTRATION. IT PROVIDED HEATED AIR (110 DEGREES TO 135 DEGREES F) IN SUFFICIENT QUANTITIES TO MAINTAIN 80 DEGREES TO 85 DEGREES F AMBIENT TEMPERATURE IN THE BROILER HOUSE. THE EXISTING DUCT VENTILATION SYSTEM CIRCULATED THE HEATED AIR TO PROVIDE A RELATIVELY UNIFORM TEMPERATURE THROUGHOUT THE BROODING AREA. THE CONCEPT AND DESIGN PROVIDED A GOOD DISTRIBUTION AND CONTROL OF HEAT WITHIN THE DEMONSTRATION HOUSE THAT WAS ACTUALLY MORE UNIFORM THAN THE ADJACENT CHECK HOUSE USING ONLY CONVENTIONAL BROODERS. COMPARATIVE

ECONOMICS FAVORED PELLETS AT $80/TON OVER PROPANE AT 60 CENTS/GALLON (CURRENT PROPANE COSTS ARE 69 CENTS/GALLON).
AS A RESULT OF THE DEMONSTRATION, ABOUT A DOZEN WOOD PELLET BROODING FURNACES HAVE BEEN INSTALLED TO SUBSTITUTE BIOMASS FUEL FOR PROPANE. REPORTED REDUCTIONS IN TOTAL COST OF BROODING VARY UPWARDS TO 25 PERCENT OVER THE SIZEABLE REDUCTIONS REALIZED BY ADOPTION OF PARTIAL-ROOM BROODING.
THE POSSIBILITY OF USING A LOW-COST-PER-BTU BIOMASS FUEL FOR POULTRY BROODING, COUPLED WITH THE OPPORTUNITY TO UTILIZE A LOCAL ENERGY RESOURCE (WOOD OR STRAW), HAS CREATED WIDESPREAD INTEREST IN THE APPLICATION AMONG POULTRY PRODUCERS AND IS EXPECTED TO CAUSE A MAJOR SHIFT TO BIOMASS BROODING WITH THE NEXT TWO YEARS.
*CONTACT
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AG50 GEORGIA PEANUT BIO-MASS CURING PROJECT

A PROJECT TO INVESTIGATE THE USE OF WOOD FOR CURING PEANUTS WAS CARRIED OUT IN AUGUST, 1982. CONVENTIONAL PEANUT CURING WAGONS HOLDING 4 TONS WERE USED AS CONTAINERS. THESE CONTAINERS HAVE PERFORATED FLOORS WITH SIDES OF MILD STEEL. BINS ARE 4 FEET IN DEPTH 14 FEET LONG AND 8 FEET WIDE.
A WOOD BURNING UNIT MANUFACTURED BY HARRINGTON MFG. CO., LEWISTON, NC WAS USED AT A HEAT SOURCE. THE UNIT WAS MODIFIED TO RECIRCULATE AIR OVER EXHAUST STACK. THE MODIFICATION INCREASED EFFICIENCY BY 44.5 PERCENT.
PEANUT CURING TESTS WERE REPLICATED FIVE TIMES COMPARING DRYING RATE BY WOOD HEAT AS COMPARED TO GAS. THE TEST DEMONSTRATED THAT OAK WOOD VALUED AT $46 PER CORD, MAY BE USED TO CURE PEANUTS OF COMPRIBLE QUALITY AT A NET SAVINGS IN FUEL COST OF 25 CENTS PER TON PER POINT OF MOISTURE REMOVED. THIS IS COMPARING COST OF CURING WITH CONVENTIONAL CONTROLS. IF FAN CYCLING IS USED IN GAS DRYING, A NET SAVINGS OF 14 CENTS PER TON OF PEANUT IS REALIZED.
CONSIDERING GEORGIA PRODUCERS ANNUALLY ARTIFICIALLY CURE 700,000 TONS PER YEAR REDUCING THE MOISTURE CONTENT BY 10 POINTS, A NET SAVINGS OF 1.75 MILLION DOLLARS PER SEASON RESULTS. INTERMITTANT GAS DRYING COSTS COULD BE REDUCED BY 980 THOUSAND DOLLARS PER YEAR. THE ANNUAL SAVINGS COMPARED TO CONTINUOUS GAS CURING WOULD BE A REDUCTION OF 27 PERCENT.
FIFTY-TWO HUNDRED DOLLARS WAS ALLOCATED FROM THE GEORGIA COMMODITY COMMISSION FOR PEANUTS TO SUPPORT THIS WORK. APPROXIMATELY 1/4 MAN YEAR HAS BEEN DEVOTED TO THIS PROJECT AND IS CONTINUING.
A BROCHURE WILL BE PREPARED TO ILLUSTRATE POTENTIAL FOR SAVING FROM THE USE OF WOOD. THESE BROCHURES WILL BE PRINTED AND DISTRIBUTED THROUGH EXTENSION AGENTS TO FARMS. SLIDE SETS ARE ALSO BEING MADE AVAILABLE FOR EDUCATIONAL USE.
MEETINGS WILL BE HELD WITH PEANUT GROWERS TO STRESS THE POSSIBLE SAVINGS BY USING BIOMASS OR WOOD AS A SOURCE FOR FUEL.
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NR826 WOOD RESIDUE UTILIZATION AND WOOD AS AN ALTERNATIVE ENERGY SOURCE IN VERMONT

BECAUSE FOSSIL FUEL ENERGY COSTS HAVE RISEN TREMENDOUSLY, VERMONT HOMEOWNERS AND SMALL BUSINESSES NEED INFORMATION AND TECHNICAL GUIDANCE OF THE FEASIBILITY OF UTILIZING WOOD RESIDUES AND FULEWOOD OPTIONS.
UVM NATURAL RESOURCES EXTENSION COMPLETED 400 ONE-TO-ONE CONTACTS, 1 WORKSHOP, 4 DEMONSTRATION TOURS, 25 RADIO TAPES, 1 TV PROGRAM AND ASSISTED IN 6 FEASIBILITY STUDIES FOR WOOD PRODUCTS INDUSTRY AND CONSUMERS AROUND THE STATE. WOOD PRODUCTS PROCESSORS AND OTHER SMALL BUSINESSES WERE TAUGHT METHODS OF CONDUCTING INDUSTRIAL WOD ENERGY FEASIBILITY STUDIES AND SHOWN ACTUAL OPERATING WOOD RESIDUE HANDLING AND COMBUSION EQUIPMENT. SMALL BUSINESS, UTILITIES & HOMEOWNERS WERE TAUGHT HOW TO SELECT WOOD ENERGY EQUIPMENT.
THE TOTAL AUDIENCE OF 500 WOOD PRODUCTS PROCESSORS, 900 LOGGERS, AND 350,000 HOUSEHOLDS IS RESPONSIBLE FOR ABOUT 900,000 CORDS OF WOOD RESIDUE PER YEAR AND 450,000 CORDS OF FUELWOOD PER YEAR. IMPROVEMENTS IN REDUCED DEPENDENCY ON FOSSIL FUELS RANGED FROM 10 TO 100 PERCENT (TOTAL CONVERSION) DEPENDING UPON CLIENT SITUATION. THESE ESTIMATES ARE TAKEN FROM EVALUATIONS BY AUDIENCE PARTICIPANTS. TRAINING SESSIONS WERE CONDUCTED ON A MULTI-COUNTY AND STATE-WIDE BASIS AND INVOLVED WOOD PRODUCTS INDUSTRY AND STATE AGENCIES. DEMONSTRATIONS AND RADIO AND TV PROGRAMS WERE STATEWIDE AND AIMED AT THE GENERAL PUBLIC. THE FOREST PRODUCTS EXTENSION SPECIALIST PROVIDED ORGANIZATIONAL LEADERSHIP, DEVELOPED INSTRUCTIONAL MATERIALS AND PROVIDED 40 HOURS FO CONTACT INSTRUCTION. INSTRUCTIONAL SUPPORT AND DEMONSTRATION EQUIPMENT WERE PROVIDED BY REPRESENTATIVES FROM WOOD PRODUCTS INDUSTRIES.
THE ENEFITS OF THESE EDUCATIONAL PROGRAMS TO HELP WOOD PRODUCTS PROCESSORS, SMALL BUSINESS AND HOMEOWNERS REDUCE DEPENDENCE ON FOSSIL FUEL ENERGY SOURCES WILL IMPROVE WOOD PRODUCTS PROCESSING EFFICIENCY, REDUCE COSTS, REDUCE EFFECTS OF INFALTION, REDUCE WASTE AND INCREASE SELF-SUFFICIENCY.
*CONTACT

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